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to distinguish the sex by the marking on the wings, so I dissected them and the result proved them males.

Again, I found a larva new to me, feeding on the soft maple. I obtained thirty-three good specimens. I was very anxious to rear these, so I watched them closely, and plied them with fresh good food; if one fell or wandered from its food I replaced it, and continued this treatment until they would eat no longer. They went into the earth to undergo transformation, and in ten or twelve days thereafter, the rare, beautiful moth, *Dryocampa rubicunda*, made its appearance. Of these there were twenty-nine females and two males. The remaining two either escaped or died in the earth.

About the time these moths came out, another lot of the same *Dryocampa* caterpillars was brought to me, but these were purposely neglected. I found them more than once wandering about the box in quest of food; some of these were killed by a parasite, others died from lack of food, so that the result proved only seven males, and no female.

THE FLYING SQUIRREL.

BY PROF. G. H. PERKINS.

OVER a year ago, I bought of some boys in central Illinois a pair of flying squirrels (*Pteromys volucella* Des.). They were only a few weeks old but were already quite tame; indeed they had never been otherwise for they were taken before they could run from the nest and so were taught to be tame at the outset. Their habits have been very closely watched since I have had them in my possession, for so amusing and interesting are they that it is quite difficult to be in the room where they are without watching their movements. I have noticed some facts in regard to them which I do not find mentioned in any account that I have seen. Intense activity characterizes them at all times, but it is more intense at some times than at others. In warm weather their movements are generally quicker and their exercise continued much longer than in cold. In summer they are more nocturnal in their habits than at other seasons.

During this season they usually lie hidden in the nest all day, rarely making their appearance before dusk, and staying out but a few minutes at a time when they do appear during the day; and what is said hereafter in regard to their activity refers especially to their habits in warm weather, though not untrue for the rest of the year. In the fall and winter months they are less strictly nocturnal, coming from the nest several times each day and taking food and exercise, after which they resume their nap, and at night they alternate sleep and activity in the same manner.

When the sleeping and waking are thus interchanged throughout the day, the squirrels are not as active in their exercise nor does the slumber seem so deep as when they sleep all day and are awake all night. The nest is a hemisphere of wire netting with an opening at the top, filled with tow and cotton. When ready to retire they plunge head foremost into this filling and, by moving from side to side, quickly bury themselves so completely that the top of the nest is left smooth and even, and gives no sign of life beneath so long as the inmates are asleep. If some inquisitive hand pulls off the material covering the squirrels, they are found at the very bottom of the nest, each rolled into as complete a ball as possible, with the broad, feather-like tail curled around one side or thrown over the face. When fairly settled for a nap they are not easily aroused, and all the return they give one for gentle pokes, pushes and strokings is a brisk, querulous scolding in sharp, squealing tones, or a blow or two from a fore paw, and then if they are still further disturbed, one or two quick bites from the sharp needle-like teeth, which, however, are so short and slender that they do not inflict very serious wounds. As has already been stated, they do sometimes come from the nest during the day, when most nocturnal in their habits, especially if thirsty; for, if hungry, they eat some of the many nuts which they have hidden in the nest. In quite marked contrast with their sprightliness of action at night are their sleepy half dazed movements at such times. Often after drinking and hopping about the cage a little, they sit motionless; for perhaps half an hour their eyes staring as if wonderstruck and thus they remain till, with a sudden leap, they bury themselves in the nest.

At dusk they begin to stir. Not all at once it would seem do they awake, for the material of the nest quivers and shakes for sometime before the squirrel appears. When, however, they con-

clude that they are all ready, out pop their heads, each to be followed by the rest of the body, after a glance on all sides with the glistening black eyes; and now all drowsiness has disappeared and an activity more incessant and intense than can be described takes its place. All night long, often with only the briefest rest now and then, these little animals are in vigorous motion, jumping, bounding, capering, running with ever varying movement and astonishing energy. Everything they do is done with all their might. It would seem to any one watching them that the exercise of the first few minutes must wholly exhaust their powers, but, on the contrary, the more their muscles are used, the more capable of use they seem, and great as is the energy of their movements at first, they usually increase in vigor and speed until after midnight and scarcely grow less before morning. Nothing affords them so much gratification as a large wheel which is placed inside the cage. Into this wheel they jump whenever aught disturbs or pleases them, and even when quite hungry they often find it necessary to take a few turns before commencing their meal, after which exercise they draw themselves into a bunch with the tail over the back after the manner of squirrels, and set briskly to work on the nut or other food which they may have received. They are almost as fond of riding as of running and work their passage by running till the wheel is in rapid motion and then clinging to its wires, and so are carried around and around, the pure white of the under side of the body contrasting prettily with the soft brownish-gray of the back and sides as each comes into view. When both are in the wheel one often rides while the other turns the wheel, the latter bounding over the other as each turn brings him around, and, no matter how rapidly the wheel turns, these movements are executed with perfect exactness and gracefulness. Being desirous of knowing with some degree of accuracy how rapidly the wheel moved, I made some experiments for that purpose and found that the usual rate of revolution was from sixty to over a hundred and twenty times a minute, and, as the wheel is forty-four inches in circumference, when its rate is the latter of the two numbers named, the squirrel turning it must travel four hundred and forty feet a minute, or about five miles an hour, a distance requiring a great many steps when they are so short as squirrels must take. The sides of the wheel are formed of spokes radiating as in any wheel, these spokes are only five inches apart at the circumference and of

course constantly grow less towards the centre; yet through this narrow space which passes, when the wheel is at full speed, in the sixteenth of a second, they dart in and out with perfect ease. So quickly do they move that the eye can scarcely follow them; one instant a squirrel is in the wheel running with all his might, and the next he is seated on a shelf at the opposite end of the cage, the wheel whirling behind him. They rarely check the speed of the wheel when wishing to leap out, but when it is in motion and one wishes to enter it, he often clings to one of the spokes and as he is borne around, sidles in. When, as in summer often occurs, the wheel is kept in motion at full speed for nine or ten hours, with very little rest, the distance which the squirrels have travelled is not inconsiderable, being much more than most men could perform day after day, and yet they never seem in the least weary but are ready at any time for a fresh start. Their chief locomotive power resides in the hind pair of legs, which are so powerful that the body can easily be held horizontally by them, the feet clinging to a wire of the cage as the only support of the whole. In most rodent animals the front legs are comparatively weak and are used mainly for holding food, and when the animal is running they seem rather to move in response to the pushing force of the hind legs than to aid very much in propelling the body. They usually move about the cage or room, or in the wheel, by running as other animals would, but sometimes they change this for a series of short leaps, or leaps which again may change into bounds of considerable length; and very graceful are these latter, so light and easy do they appear. Indeed, it is impossible for them to be awkward or clumsy in any of their movements. Though usually very quiet they are not always displeased with noise, if it be a lively one; for instance, they drop a nut in the wheel and then as it rattles when the wheel moves they are highly delighted, sometimes more so than some of the other listeners. Once when a butternut thus became quite a trouble to me I removed it, but no sooner had I left the cage than they put it back and set it rattling louder than ever, leaping over it as it came near them and jumping about as if performing a war dance, and this they repeated over and over again till, finally, the nut was removed from the cage. Now and then the freak takes one or the other to leave the wheel altogether for several days, and in the meantime they relieve their over-buoyant feelings by executing a brilliant series of somer-

sets with an agility and daring that would excite the envy of the most skilful acrobat. They always turn backward, going completely over and alighting almost exactly upon the spot from which they started. Now they run a few steps before going over, and now stop and turn round and round as if a spit ran through the centre of the body on which it turned. These gyrations are often extremely ludicrous, especially, when turning side by side, they seem to be racing. Their heads appear to be wholly ignorant of dizziness or other unpleasant sensations that come from an inverted position, for it never makes much difference with them whether the head is up or down, sometimes taking food hanging head down, and almost always drinking in this position; as they might, when wild, drink from a stream while clinging to the end of an overhanging branch, though it is singular that they should so invariably choose this position, as they drink by lapping up the water as a cat would.

They are so tame that they have very little idea of running away, not always being ready to leave the cage when it is opened to allow them to do so. They are often allowed to run about the room in which they are kept and they are quite fond of running over the furniture, leaping into chairs and off the backs, running over picture cords and the like, being better pleased as they climb higher, and when as high as they can get, off they "fly" to the farthest corner of the room. It is hardly necessary to say that this so called "flying" is in no sense true flight. The extension of skin between the front and hind limbs is not capable of motion like that of a wing of a bird, nor can it raise the body from any surface, but it is simply a support, a parachute, so that the animal can leap from a high position and by a gradual descent reach the ground. So efficient is this support that in the woods these little animals can sail down from a high tree to a bush several hundreds of feet away. They always choose a bush or branch upon which to stop if possible, and even in a room, when descending from a bookcase, they always alight, if possible, on a chair or a person's shoulder rather than upon the floor. Not only when descending but when jumping up does the parachute assist them, and if they are liable to fall they partly extend it. When fully expanded it makes the outline of the body about square, a little longer than broad, but when folded along the side it is not noticeable, as it is covered with fur of the same color as the body, white below and gray above, with a dark line along the edge, and like all the fur of

the body is most beautifully fine and soft. Like the eyes of all squirrels, those of the species under consideration are very large and unusually prominent, standing from the head like great black beads. They seem to be useful both by day and night. Light, even if it be quite bright, does not seem to be an inconvenience, and it is quite certain that they can see very well in the dark, as they leap about the cage and find their food in the darkest night as well as by daylight, and a light brought near them does not seem to affect them disagreeably. The natural food of the flying squirrel consists of nuts, buds, fruits and the like, but they are ready to at least taste of anything that may be offered them, and if it is anything that can be eaten the chances are that it will be. I once found one of them at my inkstand eagerly lapping the ink as if he enjoyed it greatly; pretty soon, however, he left it with sneezings, sniffings and grimaces of a most comical sort, but the very next chance he had he tried to get some more. Salt they eat greedily and also sugar. Beetles they are very fond of and several birds' eggs which I left in their way they devoured, shells and all. They are very neat in all their habits, keeping their faces clean by often rubbing them with the front paws, and the fur of the whole body is always clean and in order.

I am inclined to believe that the flying squirrel does not possess as much intelligence as the gray or red or some other species. Very few of their actions appear to be controlled by anything higher than instinct. They seem to be quite fond of each other, and lonely when separated for any length of time, despite an occasional sharp squabble over some article of food, but they do not evince much attachment for those who feed and care for them. In their rapid and noiseless flitting about the cage they remind one of birds, and their motions are as light and airy, but if disturbed in any way, especially when seated to enjoy a nut, they express their displeasure by a series of quick, sharp squeaks and in their quarrels they scold each other in the same manner. When especially eager to get any food that is held near the cage they run towards it with brisk chuck-chucks, at the same time shaking all over in their anxiety to seize it. More rarely they utter another sound, a clear musical note usually melodious and pleasant but occasionally shrill. This sound very closely resembles the chirp of some birds, so much so that when the windows are open and birds sing-

ing near them, a stranger almost always is deceived as to its source, thinking it caused by the birds outside rather than by the squirrels inside. They keep up this noise for perhaps ten minutes; perhaps half an hour, for no discoverable reason. They are exceedingly inquisitive, prying into everything that comes in their way; and, if watched and fearful lest they are to be interrupted, they assume a most impudent and reckless air, glancing out of one eye, and shaking their heads and sniffing every now and then for an instant, and then returning to their investigations with renewed energy, pulling away desperately at anything that can be laid hold of, and if anyone starts towards them to drive them away, they wait till the very last minute, when, with a twinkle of the eye, a toss of the head and jerk of the tail, they are off and across the room in a trice, perhaps stopping to chatter their disapproval of the whole proceeding as soon as safely out of reach. It is difficult, if not impossible, to so conceal nuts or corn that they do not immediately discover them and dig and pull and push at whatever contains them till they get them. It must be by the aid of their keen scent that they are thus able to detect the food when closely covered in a box. When their exertions have been successful, they do not allow anything that can be eaten, to remain where they have found it, however snug the place may be, but carry it off to some other place of their own choosing. One evening they carried over sixty walnuts, from a box in which they were kept, across the room and by climbing the handle of a feather duster reached a bracket on which was a large vase, and into this they put the nuts, one by one, giving each a rapping against the vase as it was left.

When the actions of an animal are so suddenly varied, so constantly changing and of such interest in all their phases as are those of the flying squirrel, a complete account can scarcely be given. Certainly it is not easy for words to represent the merry, rollicking, don't-care manner in which these flying squirrels do everything. Such a combination of earnestness and carelessness is seldom seen. For they are earnest about their work, and in emptying a box of nuts they seem to feel the great importance of their undertaking and the necessity of soberness and dignity in its execution, but yet one can not help seeing that all this is but assumed for the occasion, for their eyes, and indeed their whole body, are all the time expressive of mischief, and the little rogues

are never so sedate that they do not seem to be bubbling over with fun and to be ready at a moment's notice to engage in any mischief that may occur to their scheming little heads.*

INDIAN NETSINKERS AND HAMMERSTONES.†

BY CHARLES RAU.

THE two kinds of Indian stone implements which form the subject of this article are by no means remarkable for skilful workmanship, and therefore, probably, have thus far attracted little notice in this country. In archæology, however, every object that can serve to illustrate the former condition of a people is of significance, and it matters not whether that object is elaborately finished or has suffered but little alteration by the hand of man. I place netsinkers and hammerstones together, because the specimens in my possession, which form the basis of my description, were derived from the same locality, namely, both banks of the Susquehanna river near the small town of Muncy, in Lycoming County, Pennsylvania. I possess a great number of the above-named implements of all shapes and sizes, which were sent to me by Mr. J. M. M. Gerner, a resident of Muncy. To this gentleman I am also indebted for the communication of the details which enable me to furnish the following account.

* Since the main portion of this article was written, one of the pets has died. It is the female that is lost—the tamest and best natured, but least sprightly of the pair. It is to be feared that she was killed by kindness, as she had been fed on soft food much of the time, and so did not have to crack nuts for a living. A post mortem showed that the body was covered with thick layers of fat; and more than this, that the abdominal cavity was more than half filled with solid masses of fat; so as there was no other visible cause for her decease, the inference is that she died of *adiposity*. It is sad to say aught that may diminish any one's admiration for these really charming animals, but truth requires me to say that I have watched in vain for any signs of grief in the remaining squirrel. He sleeps as soundly and performs his various gymnastics as gleefully as ever. The only difference in his conduct I am able to detect is, that whereas formerly he instantly seized any and everything that was offered, he is now quite particular, entirely refusing many articles that used to be a part of his diet. It may be that grief affects his appetite; but it is to be feared that, having discovered that there is no one to snatch his food if he does not eat it, he takes time to choose that which is most agreeable. At any rate all the evidence goes to show that these really attractive creatures do not possess any deep affection even for each other.

† Translated by the Author from Vol. V of the "Archiv für Anthropologie."